

The functional exercise capacity and its correlates in obese treatment-seeking people with binge eating disorder

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The functional exercise capacity and its correlates in obese treatment-seeking people with binge eating disorder: an exploratory study

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Implications for rehabilitation

- The physical health should be of major concern in rehabilitation programmes for obese people with binge eating disorder.
- Physical discomfort and a reduced physical self-perception should be taken into account as potential barriers for performing daily life activities.

For Peer Review

Abstract

Purpose: The primary aim was to compare the functional exercise capacity between obese treatment-seeking people with and without binge eating disorder (BED) and non-obese controls. The secondary aim was to identify clinical variables including eating and physical activity behaviour, physical complaints, psychopathology and physical self-perception that could explain the variability in functional exercise capacity in obese people with BED.

Method: In this cross sectional study, 40 people with BED were compared with 20 age-, gender and body mass index (BMI) matched obese persons without BED and 40 age and gender matched non-obese volunteers. A 6-minute walk test (6MWT), the Baecke physical activity questionnaire, the Symptom Checklist-90, the Physical Self-Perception Profile and the Eating Disorder Inventory were administered. Physical complaints before and after the 6MWT were documented.

Results: The distance achieved on the 6MWT was significantly lower in obese people with BED ($512.1 \pm 75.8\text{m}$ versus 682.7 ± 98.4 , $p < 0.05$) compared to non-obese controls. People with BED reported significantly ($p < 0.05$) more musculoskeletal pain and fatigue after the walk test than obese and non-obese controls. In people with BED, sports participation and perceived physical strength explained 41.7% of the variance on the 6MWT.

Conclusion: Physical activity participation, physical self-perception and perceived physical discomfort during walking should be considered when developing rehabilitation programs for obese patients with BED.

Key words: Binge Eating; Walking; Obesity; Self-concept; Physical Activity

Introduction

Binge eating disorder (BED) is characterised by frequent and persistent episodes of binge eating accompanied by feelings of loss of control and marked distress in the absence of regular compensatory behaviours [1]. Furthermore, binge eating episodes are characterised with 3 or more of the following: (a) eating much more rapidly than normal, (b) eating until uncomfortably full, (c) eating large amounts of foods when not feeling physically hungry, (d) eating alone because of being embarrassed by how much one is eating, and (e) feeling disgusted with oneself, depressed, or very guilty after overeating [1]. Epidemiological studies have shown BED is one of the most common of the eating disorders, with a lifetime prevalence of 3.5% among women and 2.0% among men [2]. Although obesity is not a criterion for BED, there is a strong positive association between weight and BED symptoms and more than 65% of the people with BED are obese [3, 4]. In the literature, some differences have been reported between obese binge eaters and obese non-binge eaters. Obese binge eaters often show greater psychopathology, more weight and shape concerns and body dissatisfaction, more negative self-evaluations, and lower self-esteem compared with obese non-binge eaters [5, 6]. People with BED are also likely to habitually have more sedentary lifestyles which is in itself associated with poorer health [7-9]. In addition, obese people that binge engage in just under half the amount of physical activity compared to age and weight matched controls [10].

Because of the severe co-morbid psychiatric and physical conditions, BED has been characterised as one of the most difficult psychiatric conditions to treat [4]. Recent research [11] has identified the importance of exercise in treatment programs for BED, showing a strong impact on the body mass index (BMI) and depressive symptoms. Previous research [12] has suggested that a reduced functional exercise capacity may impede a person with BED ability to engage in physical activity and thus inhibit their potential to attain the mental and

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physical health benefits of an active lifestyle [11]. The assessment of the functional exercise capacity reflects the ability to perform activities of daily living that require sustained aerobic metabolism [13-15]. The integrated efforts and health of the pulmonary, cardiovascular, and skeletal muscle systems dictate an individual's functional exercise capacity. Numerous investigations have demonstrated that the assessment of functional capacity provides important diagnostic and prognostic information related to all the systems involved and this in a wide variety of clinical and research settings [15]. In recognition of this, several walking tests have been developed to assess an individual's functional exercise capacity in non-clinical and clinical populations [13-15].

To the best of our knowledge the functional exercise capacity has not been investigated in obese persons with BED. The clinical variables associated with functional exercise capacity are also not known and this would provide valuable information. It might be hypothesised that obesity, physical co-morbidity and a sedentary lifestyle primarily limit the functional exercise capacity whilst associated psychopathological co-morbidity might further contribute in people with BED. In addition, it is not understood to what extent the additive burden of eating disorder features and physical self-perception factors might limit people with BED functional limitations in daily life.

The primary objective of the present study therefore was to examine differences in functional exercise capacity between an obese sample of people with BED and an age and weight matched control group without BED and a normal weight control group without BED . The secondary objective was to identify clinical variables including eating and physical activity behaviour, physical complaints, psychopathology and physical self-perception that could explain the variability in the functional exercise capacity of obese people with BED.

Materials and methods

Participants and procedure

All obese people with BED seeking treatment in a weekly multidisciplinary program at the University Psychiatric Centre of the University of Leuven in Kortenberg, Belgium were invited to participate at their first treatment session [16]. The programme consists of cognitive behavioural therapy and physical activity counselling.

Obese patients with BED were compared with age, gender and body mass index (BMI) matched obese treatment-seeking patients without BED. This obese control group consisted of people seeking abdominal surgery at the University of Leuven, campus Gasthuisberg, Leuven, Belgium. The obese controls were willing volunteers who were invited to participate at their hospital appointment.

Secondly, we included a second control group who were age and gender matched non-obese controls without BED. The non-obese control group were employees of the hospitals or relatives of the research assistants who volunteered to participate.

Group stratification based on BMI for the treatment-seeking obese controls, and on age and gender for both controls groups was performed on group level by an independent statistician blinded to the aims of the study and results of the physical and mental health outcomes.

Data was collected between October 2007 and October 2012. The study procedure was approved by the Scientific and Ethical Committees of the participating centres. All participants gave their informed consent. Participation in the study did not affect the pre-treatment screening and approval process. There was no remuneration for participation in the study.

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Eligibility criteria

Only obese (BMI>30) participants meeting the DSM-IV criteria [1] for BED were included. Diagnosis was made by a psychiatrist using the Structured Clinical Interview for DSM Disorders (SCID) [17]. Patients with a severe current psychiatric condition that required residential psychiatric treatment in addition to the weekly multidisciplinary BED program were excluded.

People were excluded from the obese control people if they had a DSM-IV diagnosis for BED. Physical exclusion criteria for all participants included cardiovascular, neuromuscular and endocrine disorders which, according to the American Thoracic Society [15] might prevent safe participation in submaximal walk tests.

Functional exercise capacity: the 6 minute walk test (6MWT)

The 6MWT is a valid test for functional exercise capacity and measures the distance that a patient can quickly walk on a flat, hard surface in a period of 6 min. It evaluates the global and integrated responses of all the systems involved during exercise, including the pulmonary and cardiovascular systems, systemic circulation, peripheral circulation, blood, neuromuscular units, and muscle metabolism. It does not provide specific information on the function of each of the different organs and systems involved in exercise or the mechanism of exercise limitation, as is possible with maximal cardiopulmonary exercise testing. The test was performed in all participants according to the American Thoracic Society guidelines [15] in an indoor corridor with a minimum of external stimuli. Participants were instructed to walk back and forth around the cones during 6 min, without running or jogging. Resting was allowed if necessary, but walking was to be resumed as soon as the participants were able to do so. The protocol stated that the testing was to be interrupted if threatening symptoms appeared. Reasons for immediately stopping a 6MWT include the following: (a) chest pain,

(b) intolerable dyspnea, (c) leg cramps, (d) staggering, (e) diaphoresis, and (f) pale or ashen appearance. Standardised encouragements were provided at recommended intervals. The total distance walked in 6 min was recorded to the nearest decimeter. Supervision and measurement of the 6MWT was performed by one trained physiotherapist. Prior to the first 6MWT people were asked for conditions that might interfere with their functional exercise capacity. They were asked whether they suffered intermittently from friction of the skin, urinary stress incontinence, known hip problems or pain, foot or ankle static problems or pain. Furthermore, they were asked to rate on a Likert scale (never, seldom, sometimes, frequently or always) if they suffered from knee or low back pain. Directly after the first test physical complaints or discomforts were recorded. The 6MWT has been shown to be a reliable and feasible test to assess the functional exercise capacity in obese patients [13, 14].

Baecke Physical Activity Questionnaire

The 12-month recall Baecke Physical Activity Questionnaire [18] consists of 16 questions organised in three sections: at work (8 items), sport during leisure time (4 items), and during leisure excluding sport (4 items). Questions in each section are scored on a five point Likert scale (never, seldom, sometimes, often, and always). The two most frequently reported sports activities are explored in additional questions about the number of months per year and hours per week of participation. The three derived indices (work, sports, and leisure), are scored in units ranging from one to five. The Baecke questionnaire has previously been validated in an obese sample [19].

Symptom Checklist-90 (SCL-90)

The SCL-90 [20, 21] assesses several psychopathological complaints. It is composed of 90 items, which might be answered according to a 5-point scale, graded from 0 to 4, from “none”

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to “extremely.” The scale evaluates, besides a total psycho neuroticism scale, 8 primary domains of symptoms: agoraphobia, anxiety, depression, somatisation, cognitive-performance deficits, interpersonal sensitivity and mistrust, acting-out hostility and sleep difficulties. Higher scores indicate higher levels of psychopathology.

The Physical Self-Perception Profile (PSPP)

The PSPP consists of five sub-domain scales: (a) perceived sports competence, (b) perceived physical fitness, (c) perceived body attractiveness, (d) perceived physical strength and (e) physical self-worth [22]. Each scale consists of six items presented on a four-point structured-alternative format. Each item on the scale scores from one (least positive perception) to four (most positive perception), combining the item scores gives a sub-domain total score between six to 24 , with higher scores representing more positive perceptions. In the Dutch version for psychiatric patients, the subscales for perceived sports competence and perceived physical fitness are combined resulting in a scale score ranging from 12 to 48 [23]. It has been used previously in obese patients with severe mental illness [24].

Eating Disorder Inventory (EDI)

The EDI [25] is a widely used 64-item questionnaire aimed at assessing the psychological characteristics, eating related attitudes and traits of eating disorders. Participants are asked to respond to a 6- point forced-choice format by rating how much the item applied to them. Options range from ‘always’ to ‘never’. The most extreme eating disorder response earns a score of 3, the intermediate response scores 2, and the next response scores 1; the other three responses receive no score. We only included the bulimia subscale which consists of 7 items. The total score ranges from 0 to 21. A higher total score indicates more severe binge

pathology. Previous research demonstrated that the EDI can be used reliably for those with BED [26].

Anthropometric measures

Body weight was measured in light clothing to the nearest 0.1 kg using a SECA beam balance scale, and height to the nearest 0.1 cm using a wall-mounted stadiometer.

Statistical analyses

Descriptive statistics were undertaken and included the mean \pm SD for each variable and one-way frequency tables for the physical symptoms that might interfere with the functional exercise capacity and for the physical complaints after the walk test. The Kolmogorov-Smirnov test was used to assess the normal distribution of the data.

Analyses of variances (ANOVA) with post-hoc Scheffe were applied to assess the differences in functional exercise capacity and other demographical and clinical variables between the BED group and obese and healthy control participants.

Differences in the presence of physical complaints were assessed using the Fisher's Exact test.

Within the obese BED group, relationships with the functional exercise capacity were calculated using Pearson correlation coefficients. In order to adjust for multiple comparisons, we will only discuss those correlations with a Pearson r-value of at least 0.40 and $p \leq 0.01$.

A forward stepwise regression analysis was performed to evaluate independent variables explaining the variance in the functional exercise capacity in people with BED. The significance level was set at 0.05.

The statistical package SPSS version 22.0 (SPSS Inc., Chicago, IL) was employed for the data analyses.

Results

Participants

A total of 47 people seeking treatment for BED were initially recruited. However, several participants were subsequently excluded ($n=7$). Two persons were diagnosed with bulimia nervosa and did not meet DSM-IV criteria for BED. Two individuals with BED were excluded as a consequence of a locomotor disorder and one because of cardiovascular disorder that could prevent safe participation in the 6MWT. Two participants were excluded as they required residential treatment (one for depression and one for psychotic features). Of the 40 eligible persons, none declined to participate.

Twenty obese people without BED and 40 non-obese participants were included as controls. Demographical characteristics of all included participants are presented in table 1.

Insert table 1 about here

Differences in functional exercise capacity and clinical and demographical variables between obese people with and without binge eating and non-obese participants

Scores on 6MWT and the questionnaires for the 3 groups are shown in table 2.

The distance achieved on the 6MWT was significantly lower ($p<0.05$) in obese people with BED (main difference=-170.6m) and obese people (main difference=-147.0m) compared with the distance achieved on the 6MWT by non-obese controls. No significant differences were found between obese people with and without BED.

As can be noticed in table 2, people with BED scored significantly lower than the control groups on the sports and leisure time physical activity but not in work related physical activity. In comparison with the control groups, PSPP subscale scores were lower in the BED group (except for perceived physical strength compared with obese controls). The total and subscale scores on the SCL-90 and the EDI bulimia score were significantly higher in the

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BED group compared with the obese and non-obese controls indicating more general psychopathology and eating disorder complaints.

Insert table 2 about here

An overview of the physical conditions that might interfere with the 6MWT is given in table 3. Significantly more obese people with BED reported to suffer intermittently from friction of the skin, foot and ankle problems, back pain and knee pain than non-obese persons. No significant differences between BED and either control group was found. Physical complaints following the 6MWT are also presented in table 3. Obese people with BED experienced significantly more musculoskeletal pain, dyspnoea and pain localised at the ventral surface of the tibia than obese and non-obese controls.

Insert table 3 about here

Within the BED group, those suffering from feet and ankle problems walked significantly less than those without feet and ankle problems (465.4m versus 558.9m, $p<0.001$).

Associations of the functional exercise capacity with clinical and demographical variables in people with BED

In people with BED, the distance achieved on the 6MWT was positively associated with the level of sports participation ($r=0.57$, $p<0.001$) and perceived physical strength ($r=0.50$, $p=0.001$), and negatively with BMI ($r=-0.51$, $p=0.01$) and the SCL-90 depression score ($r=-0.43$, $p=0.009$).

Predictors of the functional exercise capacity in BED

All the significant correlates with the functional exercise capacity were included a forward stepwise regression analysis. In this forward stepwise regression analysis only Baecke sports participation and perceived physical strength were identified as independent predictors of the

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functional exercise capacity. The model explained 41.7% of the variability. Parameter estimates, standardised and unstandardised coefficients, standard error of measurements and significance of the model are shown in table 4.

Insert table 4 about here

Discussion

The present study is to our knowledge the first to demonstrate that the functional exercise capacity is greatly reduced in obese people with BED compared to obese and non-obese controls. In general, the distance walked on the 6MWT was 170.6 m shorter compared to the non-obese control group. Furthermore, we found that in obese persons with BED the functional exercise capacity was limited by lower levels of physical activity, lower physical self-perception and greater physical discomfort. We also found that muscular fatigue and pain after the 6MWT was significantly more pronounced in obese people with BED compared to obese and non-obese controls with 60% experiencing dyspnoea as the most common complaint. Musculoskeletal problems located at the knee and back were already highly prevalent before the test in the BED group. The present study therefore indicates that the physical health of obese people with BED should be of major concern in multidisciplinary treatment protocols and significantly contributes to a reduced functional exercise capacity. Considering the functional exercise capacity might in particular be of interest since it has been demonstrated in other clinical populations [27, 28] that a reduced functional exercise capacity is a significant predictor for future mortality. Data on the prognostic value of the 6MWT in people with BED are however currently lacking.

Our study also found that a reduced physical self-perception is a potential barrier to functional exercise capacity and this has implications for the initiation and maintenance of physical activity programmes aiming to improve performance of daily life activities in people

with BED in clinical practice. One model that links physical self-perception to physical activity performance is the exercise and self-esteem model (EXSEM) [29, 30]. The EXSEM states that changes in self-perception (and in particular the belief in one's capabilities to become or remain physically active) have an integral influence on changes in physical activity participation. In clinical practice, health care professionals developing physical activity programmes to increase the functional exercise capacity in people with BED should therefore be sensitive of the detrimental effects of a low physical self-perception. This is particularly important since our study indicates that obese people with BED perceive themselves as less competent in undertaking physical activity than obese people without BED. Various studies based on the EXEM model [29, 30] suggest that a positive experience of physical activity performance can enhance physical activity self-efficacy, which in turn may benefit one's physical self-perceptions and ultimately even lead to changes in self-esteem. Future research should therefore investigate which techniques can stimulate such positive experiences and consequently support an enhanced sense of personal control over the body and its functioning in people with BED. Clearly, there is a great need to encourage obese people with BED to engage in more physical activity. In the wider literature, the following recommendations [31] have been proven useful in stimulating positive experiences and consequently physical self-perceptions in persons with anxiety and depression and should be investigated in people with BED: (a) anticipating the barriers for participation by an acquaintance conversation, (b) giving information about mental and physical health benefits of physical activity, (c) helping people with BED to find a form of physical activity that suits them, (d) drawing up an individual plan with the patient taking into account emotional, cognitive and physiological and physical components of BED, (e) creating physical activity programs based on initial functional exercise capacity assessment and measurement of perceived exertion and physical discomfort during physical activity, (f) formulating realistic

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objectives improving physical activity compliance and motivation, (g) adapting the moderate physical activity stimulus to the individual's physical abilities, functional exercise capacity, expectations and goals, (h) following the programme with exercise cards and provide regular progress feedback to the participants, (i) focusing on perceived functional exercise capacity gains, reductions in physical discomfort, achievement of personal goals, mastery experiences and sense of control over the body and its functioning, (j) involving significant others and family members in the rehabilitation programmes.

The findings of the present study must however be interpreted with caution because of some methodological limitations. First, the small sample and the inclusion of almost exclusively female participants limits the generalisability of our data. Nevertheless, there was a high response rate which should prevent serious distortion of the results in these patients because of selection bias. Present findings need however to be replicated in a larger study including more male participants. A second limitation was the reliance on self-reported physical activity, a method that is prone to both systematic and random errors [32]. Thirdly, no data on smoking behaviour were collected and it is known to be a sensitive measure to detect differences in functional exercise capacity [33, 34] and smoking is common in BED [35]. Finally, the present study was cross-sectional which precludes any speculation regarding the direction of the relationships between the variables of interest. More longitudinal research is needed to better understand the potential impact of both sports activities and leisure time physical activity on weight, functional exercise capacity and physical comfort for obese people with BED.

In summary we conclude that, compared to obese and non-obese control samples, people with BED report important physical limitations when performing daily activities such a walking. They are also less physically active and have a lower physical self-perception.

Health care professionals should take into account such barriers when designing rehabilitation programs for people with BED.

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Declaration of Interest

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Table 1. Differences in demographical characteristics between treatment-seeking obese persons with and without BED and non-obese controls

	Obese persons with BED (n=40)	Obese persons without BED (n=20)	Non-obese controls (n=40)
Gender (M/F)	5/35	3/17	5/35
Age	41.0±10.9	41.4±10.0	40.4±11.0
BMI (kg/m ²)	39.2±6.0 ^a	38.2±7.2 ^b	23.8±2.9 ^{a,b}

Fisher's Exact tests (gender) ($p < 0.05$) or ANOVA with post hoc Sheffe test ($p < 0.05$): a=obese BED versus non-obese controls; b=obese non-BED versus non-obese controls; BED= binge eating disorder; BMI= body mass index.

Functional exercise capacity in binge eating

Table 2. Differences in functional exercise capacity, eating and physical activity behaviour, physical self-perception and psychopathology between treatment-seeking obese persons with and without BED and non-obese controls

	Obese persons with BED (n=40)	Obese persons without BED (n=20)	Non-obese controls (n=40)
6MWT (m)	512.1±75.8 ^a	535.7±69.0 ^c	682.7±98.4 ^{a,c}
Baecke Physical Activity			
Total score	6.8±1.5 ^{a,b}	8.0±1.3 ^b	8.8±1.0 ^a
Work	2.8±0.7	2.9±0.6	2.7±0.6
Leisure time	2.2±0.8 ^{a,b}	2.7±0.6 ^b	3.0±0.5 ^c
Sports participation	1.8±0.6 ^{a,b}	2.4±0.6 ^{b,c}	3.0±0.6 ^{a,c}
PSPP			
Sports competence/ Physical fitness	18.4±4.9 ^{a,b}	22.6±4.7 ^{b,c}	30.1±6.8 ^{a,c}
Body attractiveness	7.9±2.1 ^{a,b}	11.1±2.8 ^{b,c}	14.4±3.3 ^{a,c}
Physical strength	11.9±3.7 ^a	13.0±2.9	14.2±3.6 ^a
Physical self-worth	8.8±2.5 ^{a,b}	12.5±3.3 ^{b,c}	15.5±2.8 ^{a,c}
SCL-90			
Total score	194.6±43.5 ^{a,b}	134.3±30.2 ^{b,c}	100.2±10.2 ^{a,c}
Anxiety	20.4±7.5 ^{a,b}	13.4±4.9 ^b	10.6±0.9 ^a
Depression	39.1±12.2 ^{a,b}	26.2±8.8 ^b	17.3±2.2 ^a
Somatisation	23.1±7.0 ^{a,b}	19.3±6.2 ^{b,c}	13.6±2.6 ^{a,c}
Cognitive-performance deficits	21.9±5.9 ^{a,b}	14.7±4.3 ^b	10.5±1.4 ^a
Interpersonal sensitivity	39.8±12.7 ^{a,b}	26.8±8.1 ^b	20.8±4.1 ^a
Acting-out hostility	10.3±2.6 ^{a,b}	8.2±2.3 ^b	6.4±0.7 ^{a,c}
Agoraphobia	11.4±4.2 ^{a,b}	7.7±1.0 ^b	7.2±0.6 ^a
Sleep difficulties	7.7±3.6 ^{a,b}	5.8±2.4 ^b	4.0±1.6 ^a
EDI Bulimia score	9.0±4.7 ^{a,b}	1.9±2.2 ^b	0.33±1.2 ^a

BED= binge eating disorder; PSPP= physical self perception profile; SCL-90= symptom checklist-90; EDI= eating disorders inventory; ANOVA with post hoc Sheffe test (p<0.05):a=obese BED versus non-obese controls; b= obese BED versus obese non-BED; c=obese non-BED versus non-obese controls.

Functional exercise capacity in binge eating

Table 3. Differences between treatment-seeking obese persons with and without BED and non-obese controls in the presence of physical complaints and discomforts before and after the walk test

	Obese persons with BED (n=40)	Obese persons without BED (n=20)	Non-obese controls (n=40)
Friction of the skin pre	12 (30.0%) ^a	5 (25.0%) ^c	0 (0%) ^{a,c}
Urinary stress incontinence pre	7 (17.5%) ^a	4 (20.0%) ^c	1 (2.5%) ^{a,c}
Hip pain pre	4 (10.0%) ^a	3 (15.0%) ^c	1 (2.5%) ^{a,c}
Foot static problems or pain pre	20 (50.0%) ^a	11 (55.0%) ^c	6 (15.0%) ^{a,c}
Back pain pre	34 (85.0%) ^a	19 (95.0%) ^c	27 (67.5%) ^{a,c}
Knee pain pre	34 (85.0%) ^a	19 (95.0%) ^c	6 (15.0%) ^{a,c}
Musculoskeletal pain post	19 (47.5%) ^{a,b}	5 (25.0%) ^{b,c}	2 (5.0%) ^{a,c}
Dyspnoea post	24 (60.0%) ^a	10 (50.0%) ^c	2 (5.0%) ^{a,c}
Muscular fatigue post	16 (40.0%) ^{a,b}	3 (15.0%) ^{b,c}	2 (5.0%) ^{a,c}
Tibia pain post	18 (45.0%) ^{a,b}	3 (15.0%) ^b	8 (20.0%) ^a

BED= binge eating disorder; Fisher's Exact tests ($p < 0.05$): a=obese BED versus non-obese controls; b= obese BED versus obese non-BED; c=obese non-BED versus non-obese controls.

Table 4. Forward stepwise regression analysis with the functional exercise capacity as the dependent variable

Variables°	Adjusted r ²	B	SE	β	P
Baecke sports	0.337	49.1	18.1	0.421	0.011
PSPP physical strength	0.417	6.6	3.1	0.325	0.044

°Only significant correlates were included in the model, B=unstandardized coefficient, SE= standard error, β= standardized coefficient, PSPP= Physical Self Perception Profile.